Practice Exam 1

1. The mol fraction of NH_4Cl in a solution is 0.0311. What is its molality? (The molar mass of water is 18.016 g/mol.)

    a. 1.78 m

    b. 1.66 m

    c. 0.969 m

    d. 0.562 m

    e. 0.0983 m

2. What is the molarity of a 25.0% HCl solution if the density is 1.08 g/cm^3?

    a. 2.70 M

    b. 2.96 M

    c. 5.49 M

    d. 7.41 M

    e. 9.11 M

3. Which of the following gases do you expect to have the highest Henry's Law gas constant for water at 25 ºC?

    a. CO_2

    b. HCN

    c. N_2

    d. O_2

    e. Ne

4. Which of the following solvents should Na^+ ion have the highest solvation energy in?

    a. $H_2O(l)$

    b. $CS_2(l)$

    c. $CCl_4(l)$

    d. $CH_3CH_2CH_2CH_2CH_2CH_3(l)$

    e. $CH_3OH(l)$

5. Which of the following changes in the property of a salt would increase its heat of hydration?

   a. a decrease (weakening) in lattice energy
   b. a decrease in hydration energy of the cation
   c. a decrease in hydration energy of the anion
   d. an increase (strengthening) in lattice energy
   e. an increase in the melting point of the salt

6. What is the molar mass of a compound if 5.96 grams is dissolved in 25.0 grams of chloroform solvent to form a solution which has a boiling point elevation of 4.80 ºC? The boiling point constant of chloroform is +3.63 ºC/m.

   a. 112 g/mol
   b. 132 g/mol
   c. 180 g/mol
   d. 342 g/mol
   e. 451 g/mol

7. What is the osmotic pressure of a 0.100 M aqueous solution of urea at 25 ºC?

   a. 244 atm
   b. 24.4 atm
   c. 3.82 atm
   d. 2.44 atm
   e. 0.244 atm

8. Consider the reaction

$$S_2O_8^{2-} + 3\ I^- \rightarrow 2SO_4^{2-} + I_3^-$$

   which one of the following rate expressions would give the same value as the rate of disappearance of $S_2O_8^{2-}$?

   a. rate = $-3\ \Delta[I^-]/\ \Delta t$
   b. rate = $-1/3(\Delta[I^-])/\ \Delta t$
   c. rate = $-2(\Delta[SO_4^{2-}])\Delta t$
   d. rate = $-\ \Delta[I_3^-]/\ \Delta t$
   e. rate = $-1/2(\Delta[SO_4^{2-}])/\Delta t$

9. The exponents in a rate law are determined by

    1. the coefficients in the balance equation.
    2. experiment.
    3. the physical states of the reactants and products.

    a. 1 only

    b. 2 only

    c. 3 only

    d. 1 and 2 only

    e. 1, 2, and 3

10. After five half-life periods for a first-order reaction, what is the molarity of a reagent initially at 0.366 M?

    a. 1.14×10^{-2}

    b. 3.12×10^{-2}

    c. 6.57×10^{-3}

    d. 3.12×10^{3}

    e. 7.32×10^{-2}

11. If the half-life of a first-order process is 3.00 minutes, the rate constant for the process is

    a. 1.50/min.

    b. 1.05/min.

    c. 4.34/min.

    d. 0.405/min.

    e. 0.231/min.

12. Under which of the following conditions does the equilibrium constant K change for the reaction

$$H_2(g) + I_2(g) \leftrightarrow 2HI(g)$$

    a. changing the size of the container

    b. Introducing more I_2 into the container

    c. measuring the molar concentrations instead of pressures

    d. changing the temperature

    e. none of these, it is always constant

13. Hydrogen peroxide decays into water and oxygen in a first-order process.

$$H_2O_2(aq) \rightarrow H_2O(\rangle) + 1/2\ O_2(g)$$

where the rate expression is $-\Delta[H_2O_2]/\Delta t = k[H_2O_2]$. If we begin with 0.100 M H_2O_2 and find that after 3200 seconds, the peroxide concentration falls to 0.0825 M, what is the rate constant, k, at the temperature at which the experiment is performed?

a. $2.61 \times 10^{-5}\ s^{-1}$
b. $6.01 \times 10^{-5}\ s^{-1}$
c. $6.59 \times 10^{-5}\ s^{-1}$
d. $3.79 \times 10^{-4}\ s^{-1}$
e. $4.24 \times 10^{-3}\ s^{-1}$

14. In basic solution, $(CH_3)_3CCl$ reacts according to the equation

$$(CH_3)_3CCl + OH^- \rightarrow (CH_3)_3COH + Cl^-$$

The accepted mechanism for the reaction is

$$(CH_3)_3CCl \rightarrow (CH_3)_3C^+ + Cl^- \text{ (slow)}$$
$$(CH_3)_3C^+ + OH^- \rightarrow (CH_3)_3COH \text{ (fast)}$$

What is the rate law expression for the reaction?

a. rate = $k[(CH_3)_3C^+],[OH^-]$
b. rate = $k[(CH_3)_3C^+][OH^-]$,
c. rate = $k[Cl^-]$
d. rate = $k[(CH_3)_3CCl]$
e. rate = $k[(CH_3)_3CCl][OH^-]$

15. The activation energy for $2N_2O(g) \rightarrow 2N_2(g) + O_2(g)$ is 250. kJ. If k for this reaction is 0.380 $M^{-1}s^{-1}$ at 1001 K, what will k be at room temperature, 298 K?

a. 6.36×10^{-32}
b. 4.35×10^{-16}
c. 0.113
d. 0.216
e. 1.57×10^{31}

16. If $K_C = 0.44$ for the reaction $2NOBr(g) \leftrightarrow 2NO(g) + Br_2(g)$ at a particular temperature, what is K_C for the following reaction?

$$NOBr(g) \leftrightarrow NO(g) + 1/2Br_2(g)$$

a. 0.19
b. 0.22
c. 0.44
d. 0.66
e. 2.3

17. A chemist prepared a sealed tube with 0.85 atm of PCl_5 at 500 K. The pressure increased as the following reaction occurred. When equilibrium was achieved, the pressure in the tube had increased to 1.25 atm. Calculate K_p.

$$PCl_5(g) \leftrightarrow PCl_3(g) + Cl_2(g)$$

a. 0.36
b. 0.19
c. 0.10
d. 0.047
e. 0.089

18. A 1.00 liter flask contained 0.24 mol NO_2 at 700 K which decomposed according to the following equation. When equilibrium was achieved, 0.14 mol NO was present. Calculate K_C.

$$2NO_2(g) \leftrightarrow 2NO(g) + O_2(g)$$

a. 9.6×10^{-3}
b. 1.1×10^{-2}
c. 9.8×10^{-2}
d. 1.4×10^{-1}
e. 5.7×10^{3}

19. A mixture of 0.30 mol NO and 0.30 mole CO_2 is placed in a 2.00 L flask and allowed to reach equilibrium at a given temperature. Analysis of the equilibrium mixture indicated that 0.10 mol of CO was present. Calculate K_C for the reaction.

$$NO(g) + CO_2(g) \leftrightarrow NO_2(g) + CO(g)$$

a. 0.033

b. 0.05

c. 0.25

d. 1.1

e. 0.33

20. A flask contains the following system at equilibrium:

$$Mg(OH)_2(s) \leftrightarrow Mg^{2+}(aq) + 2\ OH^-(aq)$$

Which of the following reagents could be added to increase the solubility of $Mg(OH)_2$?

a. NH_3

b. NaOH

c. HCl

d. H_2O

e. $MgCl_2$